Section Five Fluid and ideal gas

Part one

Arterial stenosis is a constriction of an artery, often due to plaque buildup on the artery's inner walls. Serious medical conditions can result, depending on the affected artery. Stenosis of the carotid arteries that supply blood to the brain is a leading cause of stroke, while stenosis of the renal arteries can lead to kidney failure. Pulmonary artery stenosis results from birth defects, and can result in insufficient oxygen supply. Because the heart has to work harder to get blood through a constricted artery, stenosis can contribute to high blood pressure. In answering the questions below, assume steady flow (which is true in arteries only on short time scales).

1. How does the volume flow rate of blood at a stenosis compare with the rate in the surrounding artery?

a. lower

b. the same

c. higher

2. How does the blood flow speed at a stenosis compare with the speed in the surrounding artery?

a. lower

b. the same

c. higher

3. Which of the following medical problems is more likely to occur?

a. An artery might collapse because of lower blood pressure at the stenosis.

b. An artery might burst because of higher blood pressure at the stenosis.

c. Neither; pressure at the stenosis is the same as in the surrounding artery.

4. If the artery has circular cross section even at the stenosis, but the diameter at the stenosis is half that in the surrounding artery, the blood flow speed in the stenosis will be

a. one-fourth that in the surrounding artery.

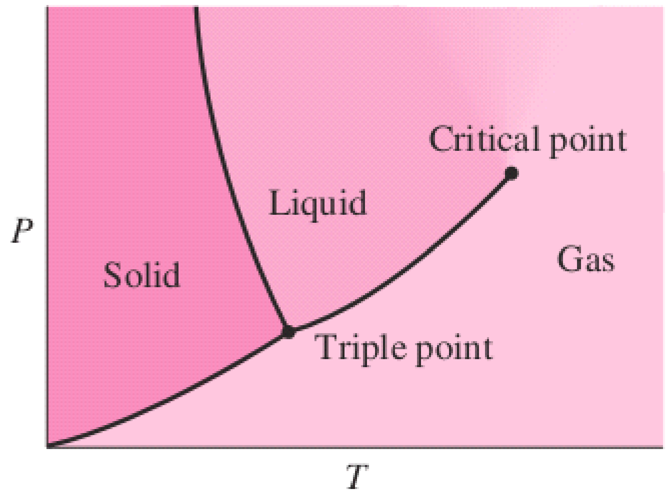
b. one-half that in the surrounding artery.

c. the same as in the surrounding artery.

d. times that in the surrounding artery.

e. four times that in the surrounding artery.

A pressure cooker is a sealed pot that cooks food much faster than most other methods because increased pressure allows water to reach higher temperatures than the normal boiling point (Fig.5.1). Pressure cookers afford many advantages: faster cooking, lower energy consumption, and less vitamin loss. The pressure-cooker principle is also used in autoclaves for sterilizing surgical instruments in hospitals and equipment in biology labs.



5. In water's phase diagram (Fig. 5.2), normal boiling occurs at a point on the line between the triple point and the critical point. In a pressure cooker, boiling occurs

a. at a point in the diagram directly above where it normally occurs.

b. higher up on the line between the triple and critical points.

c. at a point directly to the right of where it normally occurs.

d. beyond the critical point.

6. A typical pressure cooker operates at twice normal atmospheric pressure, raising water's boiling point to about 120℃， Compared with steam at 1 atm and the normal boiling point, the density of steam in a pressure cooker is

a. double.

b. somewhat more than double.

c. somewhat less than double.

d. quadruple.

7. Because some pathogens can survive temperatures at 120 ℃ , medical autoclaves typically operate at 3 atm pressure, where water boils at 137℃. Based on this information and that given in the preceding problem, you can conclude that

a. Fig. 5.2's depiction of the liquid-gas interface for water is correct in being concave upward.

b. Fig. 5.2's liquid-gas interface should actually be concave downward.

c. autoclaves operate above the critical point.

d. at its operating temperature, there can't be any liquid water in the autoclave.

8 . A pressure cooker has a regulating mechanism that releases steam so as to maintain constant pressure. If that mechanism be-came clogged

a. the pressure would nevertheless level off once water in the cooker began to boil.

b. the pressure would continue to rise although the temperature would remain constant.

c. both temperature and pressure would continue to rise.

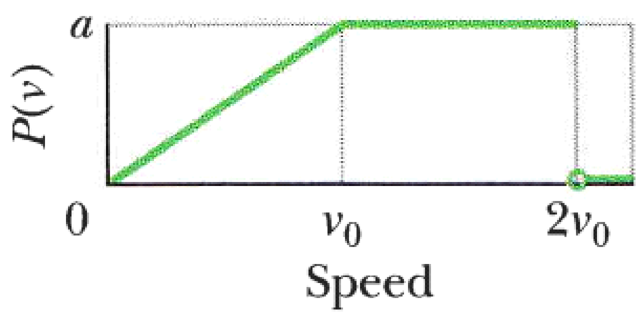
d. the density of the steam would decrease.

Part Two

1 Estimate the rms speed of an amino acid whose molecular mass is 89 u in a living cell at 37 degrees How about the rms speed of protein of molecular mass 50,000 u ? u is atomic weight

unit.

2 Figure 5.3 shows a hypothetical speed distribution for a sample of N gas particles (note that P(v)=0 for speed $v>2v_0$). What are the values of (a) av_0, (b) v_{avg}/v_0 (c) v_{rms}/v_0 d) what fraction of the particles has a speed between $1.5v_0$ and $2.0v_0$



3 At what frequency do molecules (diameter 290 pm) collide in (an ideal) oxygen gas at temperature 400 K and pressure 2.00 atm?

4 Figure 5.4 shows a stream of water flowing through a hole at depth h=1.0cm in a tank holding water to height H =40 cm. (a) At what distance x does the stream strike the floor? (b) At what depth should a second hole be made to give the same value of x? (c) At what depth should a hole be made to maximize x?